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(71) Applicant (for all designated States except US): KYUNG-WON ENTERPRISE CO., LTD. [KR/KR]; RM 809 Winners Officetel, 175-2, Chamsil-dong, Songpa-gu, Seoul 138-220 (KR).

(71) Applicant and

(72) Inventor: KIM, Hee, Jung [KR/KR]; 7-305, Asia Seon-suchon Apt., 86, Chamsil-dong, Songpa-gu, Seoul 138-220 (KR).

(74) Agent: LEE, Hoo, Dong; 7th-11th floors, Hankook Tire Building, 647-15, Yoksam-dong, Kangnam-ku, Seoul 135-723 (KR).

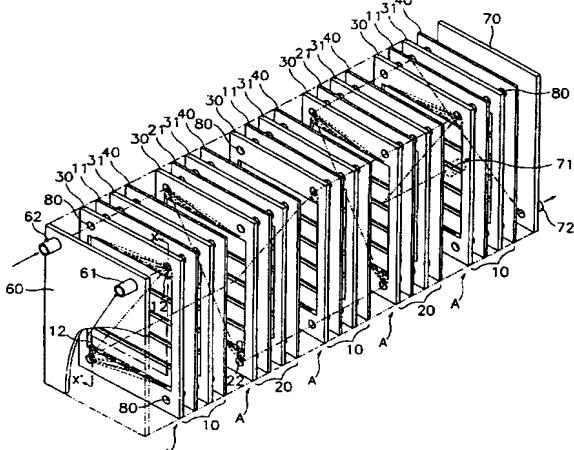
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(54) Title: APPARATUS FOR PREPARING STERILIZING WATER AND PROCESS FOR STERILIZING WATER



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(57) Abstract: The present invention provides an apparatus for preparing sterilizing water, which comprises an electrolyzer wherein an anode chamber (10) and a cathode chamber (20) partitioned by an ion exchange membrane (40) form a unit cell (A), being alternately arranged and successively equipped with close relation; water inlets (61, 62) and water outlets (71, 72) are provided on the end plate (60, 70) at both ends of the electrolyzer; said anode chamber (10) and cathode chamber (20) having circulative openings at the vicinity of each edge at both sides centered from anode plate (11) and cathode plate (21), of which two circulative openings of diagonal direction among them have plural passages of fan-shape, in order for water introduced through the openings to pass through the passages to rapidly go through each electrode; and a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) having plural horizontal members are provided at the center to form an anode reaction chamber (13) and a cathode reaction chamber (23).

APPARATUS FOR PREPARING STERILIZING WATER  
AND PROCESS FOR STERILIZING WATER

**TECHNICAL FIELD**

5 The present invention relates to an apparatus for making water sterilized, which can sterilize various microorganisms living upon the living environment, by electrolysis of water, and a process of the sterilization.

10 **BACKGROUND ART**

Up to the present, disinfectants such as hydrogen peroxide, povidone iodine solution and phenol for preventing infection in a hospital, sodium hypochlorite (NaOCl) for sterilization of food and kitchen, alcoholic cleaners and agricultural chemicals commonly used in the field of agriculture, have been used.

However, using these chemicals involves problem of occurrence of transformed resistant bacteria upon the increased use of the amount, and causes problems of 20 environmental pollution and treatment of waste water. In addition, these chemicals have serious problems in safety because they may cause allergy or skin irritation and even death when inhaled in a large amount.

25 **DISCLOSURE OF THE INVENTION**

Thus, the present invention provides a series of electrolyzers which comprises unit cells consisting of anode and cathode chambers having anode and cathode plates at the center of gaskets having plural horizontal members 30 and plural anode and cathode passages of fan-shape, said anode and cathode chambers being partitioned by ion exchange membrane, to electrolyze water with an electric current of 100 A or less, and electric potential of 100 V or less. According to the invention, an apparatus to 35 prepare water for sterilizing various kinds of microorganisms with pH 2.0 to 3.5 and redox potential of 950 to 1,200, and a process for the sterilization are

provided.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a divisional perspective view of the apparatus according to the present invention, which shows the flow of water.

Fig. 2 is a sectional view of the assembled structure of the apparatus according to the present invention.

Fig. 3 is an extracted perspective view of the apparatus according to the present invention.

#### BEST MODE FOR CARRYING OUT THE INVENTION

The electrolyzer according to the present invention comprises anode chambers (10) and cathode chambers (20) partitioned by ion exchange membrane (40). The anode chamber (10) and cathode chamber (20) form a unit cell (A), and the unit cells are alternately arranged with a close contact. At both sides of the electrolyzer, end plates (60 and 70) having water inlets (61, 61') and water outlets (71, 71'), respectively, are provided to form an outlined construction of the electrolyzer.

As described above, on the end plates (60 and 70), a couple of water inlets (61, 62) and a couple of water outlets (71, 72) are formed, and water being introduced from one water inlet (61) flows through the anode chamber (10) to be discharged as acidic water at one water outlet (71), while water being introduced from the other water inlet (62) flows through the cathode chamber (20) to be discharged from the other water outlet (72) as alkaline water.

Each anode chamber (10) and cathode chamber (20) commonly comprises a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) at both sides of anode plate (11) and cathode plate (21), respectively to form a unit cell. In each gasket (30, 31), an anode passage (12) and a cathode passage (22) are respectively formed in a diagonal direction, which leads to an anode

reaction chamber (13) or a cathode reaction chamber (23).

The structure of each electrode plate (11, 21) and gasket (30, 31) used in the apparatus for preparing sterilizing water according to the present invention is 5 examined. As illustrated in Fig. 3, circulatory openings are provided on each edge to pass the water that has been introduced through the water inlet (61, 62). Plural passages of fan-shape are formed in two openings among them in a diagonal direction, so that water introduced 10 through the circulatory opening may pass out through the passage, and then rapidly pass through each electrode to facilitate electrolytic reaction. Number of the plural passages formed in the circulatory openings are preferably three or more, and more preferably 4. In addition, at the 15 center of gaskets (30, 31), plural horizontal members are provided to prevent deterioration of electrolytic power owing to the contact of ion exchange membrane with the electrode.

According to conventional electrolysis, the life of 20 ion exchange membrane is short because Ca or Mg precipitate produced as a reaction side product is concentratedly deposited on the narrow surface of the membrane when it passes through the narrow passage. However, the apparatus according to the present invention 25 provides a wide passage of fan-shape as illustrated in Fig. 3, so that the precipitate may pass through the ion exchange membrane by smoothly passing the passage, thereby preventing the deterioration of ion exchange membrane. Due to the structure of wide passage of fan-shape, 30 discharge of gas generated from electrolysis is promoted to increase the efficiency of electrolysis, and the lifetime of electrodes become longer.

Since each anode or cathode passage (12, 22) of the anode chamber (10) and cathode chamber (20) is only formed 35 in an opposite diagonal direction, the water introduced from one water inlet (61) moves through each circulatory opening (80) of the anode chamber (10) and then flows into

the anode reaction chamber (13) through the anode passage (12) formed in each gasket (30,31) in the anode chamber (10), while the water introduced from the other water inlet (62) simply passes through the corresponding opening 5 (80) in which no anode chamber passage (12) has been formed in the unit cell (A) of the anode chamber (10) to reach the cathode chamber (20), where the water discharged from the cathode passage (22) formed in each gasket (30,31) of the cathode chamber (20) flows into the cathode 10 reaction chamber (23). In other words, the water introduced into the anode chamber (10) flows only into the anode reaction chamber to be reacted and then passes through the opening (80) to flow into only the anode chamber (10) of the next unit cell (A), while the water 15 introduced into the cathode chamber (20) flows only into the cathode reaction chamber (23) to be reacted and then repeatedly flows into the cathode chamber (20) of the next unit cell (A).

Now, the operative process of the present invention 20 is described in detail.

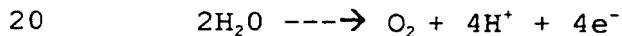
When water is introduced into the electrolyzer through the water inlet (61,62), it is discharged through the upper anode passage (12) formed in the gasket (30, 31) from the first anode chamber (10), upon flowing into the 25 electrolyzer through the circulatory opening (80). The discharged water flows down with the anode plate in contact (11), so that the water loses electrons by electrolytic reaction in the anode reaction chamber (13) to become acidic. The water passes through the lower 30 anode chamber passage (12) while it is electrolyzed, and passes through the opening (80) to simply pass through the next cathode chamber (20). When the water reaches the unit cell (A) of the anode chamber (10) again, the water 35 is discharged through the lower passage (12) of each gasket (30, 31), and then passes again through the upper passage (12), and further electrolyzed by contacting with the anode plate (11) in the anode reaction chamber (13) to

become more acidic.

Meanwhile, the water introduced through the other water inlet (62) simply passes through the unit cell (A) of the first anode chamber (10) via the circulatory 5 opening (80) to reach the cathode chamber (20) and then discharged through the upper cathode passage (22) formed in each gasket (30, 31) of the cathode chamber. Then, the water flows down with the cathode plate in contact (21) in the cathode reaction chamber (23) to gain a large amount 10 of electrons by electrolysis and becomes alkaline.

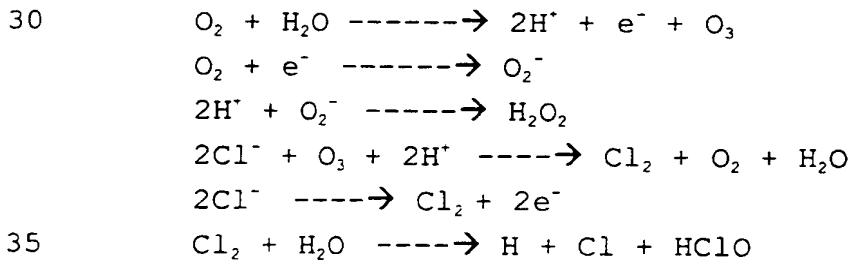
The water reacted as described above is discharged via the lower cathode passage (22) to pass through the opening (80) and then flows into the cathode reaction chamber (23) via the cathode passage (22) of the cathode 15 chamber (20) to be subjected to the repeated operation of electrolysis.

In the anode chamber (10), oxygen, hydrogen ion and oxygen radical are generated by oxidation of water to give acidic water.



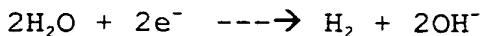
At this time, oxygen ( $O_2$ ) is dispersed into the air to increase the concentration of hydrogen ion in the anode chamber to raise pH and the redox potential.

Meanwhile, the substances in molecular state, such as 25 oxygen, carbon dioxide and calcium carbonate and the anions such as chloride ion or bicarbonate ion, which are contained in piped or underground water, are reacted as follows to give ozone, superoxide anion, hydrogen peroxide and hypochlorous acid.



On the other hand, in the cathode chamber (20), hydrogen and hydroxide ion are generated by reduction of

water as follows to give alkaline water.



The method for preparing acidic water and alkaline water by means of electrolysis of water using anode and 5 cathode has been generally used.

However, the present invention provides more effective apparatus for preparing acidic and alkaline water by using such anode and cathode chambers, and further provides a structural apparatus to produce 10 sterilizing water with excellent sterilizing effect in a large scale.

According to the present invention, the anode plate (11) and the cathode plate (21) use proper catalysts to promote the reaction of the anode chamber and reaction of 15 the cathode chamber respectively.

The anode plate (11) generally employs a dimension stable anode (DSA) using oxides of iridium or ruthenium as an oxygen-generating catalyst or platinum plating on titanium substrate.

20 The cathode plate (21) employs hydrogen or oxygen generating catalyst (such as oxides of iridium or ruthenium) in addition to stainless steel, nickel, mild steel or titanium substrate.

The ion exchange membrane (40) comprises of 25 fluororesin or hydrocarbon type ion exchange membrane. According to the present invention, the electrolytic potential is lowered by using Sn-Ir-Pt complex electrode having low hydrogen generation potential, while the gap-control gaskets (30) which adjust the distance between the 30 electrodes are provided with a thickness of 2 mm or less, considering the potential between an electrode and the other.

Further, the material for the gap-control gaskets (30) and gaskets for preventing leakage of electrolytes 35 (31) is generally selected from EDPM rubber, silicone, teflon, and the like.

The unit cell (A) of the present invention is set in

a housing frame and is tightly assembled by using nuts and bolts. All anodes and cathodes of the present invention are electrically connected to the positive and negative terminals of a current supply source, while the outlet for 5 the acidic water has a sensor for detecting the redox potential so that it may continuously measure the value to control the potential of a rectifier using a controller or to control the acidity using a flow controller.

According to the present invention, the electric 10 current is set to a level of not higher than 100 A, while the voltage is set to a level of not higher than 100 V, depending upon the flow rate of water supplied to the electrolyzer. The system is evaluated by measuring 15 electric potential and pH by the lapse of time so as to obtain acidic water of high quality.

The acidic water electrolyzed via the electrolyzer according to the present invention has pH of 2.0 to 3.5 and very high redox potential of 950 to 1,200 mV. That is, 20 the acidic water has strong sterilizing action, since it has such a low electron concentration that takes the electrons of bacterial cells instantly to break the cell membrane and extinguish bacteria.

The sterilizing water prepared according to the present invention is generated from an apparatus for 25 preparing electrolyzed water, which is divided into anode and cathode chamber. The acidic water in the anode comprises superoxide ( $O_2^-$ ), hydrogen peroxide, ozone, hypochlorous acid, or the like, having strong oxidizing ability which oxidizes or denaturalizes the amino acid 30 group on the surface of bacteria or fungi harmful to a human body or environment. Thus, the water has strong sterilizing power to extinguish the harmful bacteria in 5 to 30 seconds.

Accordingly, the apparatus for preparing sterilizing 35 water according to the present invention can be used for preventing harmful insects, for sterilization and cleaning of various agricultural and stockbreeding products in the

field of agriculture and stockbreeding, as well as cleaning of devices or human body to prevent infection in the field of medical treatment. Further, the apparatus can be widely used for various applications, for example, 5 sterilizing or controlling sanitary condition in food processing industries, restaurants, hotels or houses.

In the apparatus for electrolyzing water according to the present invention, depolarized ion exchange membrane (40) is provided to prevent hydrogen ion generated in the 10 anode chamber (10) from being moved into the cathode chamber (20), while preventing hydroxyl ion generated in the cathode chamber (20) from being moved into the anode chamber (10) to maximize the productivity of water.

The ion exchange membranes (40) usable in the 15 electrolytic system according to the present invention include commercially available ion exchange membranes such as fluoride or hydrocarbon type ion exchange membrane merchandised by Dupont Co. of U.S.A., Asahi Chemical Co. or Asahi Glass Co. of Japan, or depolarized ion exchange 20 membranes comprising integrated anion and cation exchange membrane manufactured by Dokuyama Soda Co. of Japan.

The invention is described in more detail by referring to the examples below, but it should be noticed that the present invention is not restricted to the 25 examples by any means.

#### Example 1

Tap water is supplied into an electrolyzer according to the present invention at a flow rate of 10 liter per 30 minute, and the current is constantly supplied as 50 A. Electric potential and pH are measured with the lapse of time to evaluate the system and to prepare acidic water. The physicochemical properties of sterilizing water finally obtained by the apparatus according to the present 35 invention were compared with conventional piped water, and the results are shown in Table 1.

Table 1. Physicochemical properties of the

sterilizing water of the present invention

	Sterilizing water of the present invention	Tap water
pH	2.0 - 3.5	6.8 - 7.7
Redox potential (mV)	950 - 1,200	350 - 550
Conductivity ( $\mu\text{s}/\text{cm}$ )	1.7	1.4
$^{17}\text{O-NMR}$ half-width (Hz)	55 - 65	140 - 150

Example 2: Test for sterilizing ability

5

(1) Preparation of inoculation source

The test sample at the contact time "0" and the control sample were properly diluted with beef broth culture medium after 24 hour cultivation to make the regenerated bacterial number  $1\text{-}2 \times 10^6$ , and the resultant 10 bacterial solution 1 ml was used as an inoculation source. For the dilution of the culture medium, physiological saline was used.

10

(2) Preparation of test sample and control sample

In an 237 ml of wide neck glass container having a 15 screw-type lid, test sample and control sample were prepared respectively. For the control sample, the same amount of phosphoric buffer solution without containing the test sample was placed. The control sample inoculated with bacteria was used as a control means against the 20 inoculated test sample.

20

(3) Inoculation and cultivation of test sample and control sample

Bacteria cultivated for 24 hours was shaken and stood for 15 minutes before preparing the inoculation source. 25 Then, 1 ml of the inoculation source was carefully dropped on the test sample and control sample to be evenly dispersed.

Phosphoric buffer solution (pH 7.2) was added as a neutralizing solution to each glass vessel containing

inoculated control sample and glass vessel containing inoculated test sample soon after inoculation (within 30 seconds). The sample was diluted, and a portion was taken and inoculated by thinly spreading it on a plate medium 5 containing agar and tryptophan glucose extract. The inoculated samples were cultivated in a plate cultivator at 37°C for 48 hours, and the number of bacteria was counted.

The results are shown in Table 2.

10 Table 2: Sterilizing power of the sterilizing water of the present invention

	Control sample (5 min)	No. of bacteria after treating with sterilizing water of the invention for 30 seconds (cfu/ml)	Sterilizing power (%)
<i>E. coli</i> O-157	$3.6 \times 10^3$	0	99.9
<i>Salmonella typhimurium</i>	$3.2 \times 10^3$	0	99.9
<i>Bacillus subtilis</i>	$2.0 \times 10^3$	0	99.9
<i>Enterobacter cloacae</i>	$3.0 \times 10^3$	0	99.9
<i>Klabsiella pneumoniae</i>	$3.3 \times 10^3$	0	99.9
<i>Shigella flexneri</i>	$3.6 \times 10^3$	0	99.9
<i>Candida albicans</i>	$2.6 \times 10^3$	0	99.9
<i>Trichophyton rubrum</i>	$2.6 \times 10^3$	0	99.9
<i>Aspergillus niger</i>	$2.2 \times 10^3$	0	99.9

Penicillium funiculosum	$3.2 \times 10^3$	0	99.9
Valsa ceratosperma	$3.8 \times 10^3$	0	99.9

As can be seen from the results of Table 2, it was confirmed that sterilizing water prepared from the apparatus for preparing sterilizing water according to the 5 present invention has an excellent sterilizing power against bacteria causing food poisoning or pathogenic infections and fungi causing sanitary or infectious problems in the environment or daily commodities.

Example 3: Effect of preventing agricultural diseases

10

(1) Preparation of inoculation source

Each sample infected with red pepper white powder disease, cucumber bacterial disease, cucumber white powder disease, grape bacterial disease, strawberry white powder disease, bacterial brown spot of agaric and green mold disease was taken, and the infectious bacteria was isolated. The isolated strain was cultivated in nutrient agar medium at 25°C. The concentration of living bacteria was measured by subsequent dilution of the cultured bacteria.

20

(2) inoculation of the cultured bacteria and measurement of number of living bacteria

Sterilizing water (9.9 ml) prepared according to Example 1 of the present invention was charged in a test tube, and each 0.1 ml of bacteria at a concentration of 25  $10^{10}/\text{ml}$  was inoculated, and the mixture was reacted for 30 seconds. The reaction mixture (0.1 ml) was inoculated on nutrient agar medium (which had been previously prepared), and cultivated at 25°C for 24 hours. The number of colonies generated was counted to determine the extinction 30 rate. For the control group, identical experiments were repeated by using commercially available agricultural chemicals.

The results are shown in Table 3 below.

Table 3. Effect of preventing agricultural diseases

	Prevention (%)		
	Sterilizing water of the invention	Commercially available agricultural chemicals	No treatment
red pepper white powder disease	67.8	51.0	0
Cucumber bacterial disease	21.4	17.7	0
Cucumber white powder disease	77.9	66.1	0
grape bacterial disease	90.8	91.7	0
Strawberry white powder disease	76.8	78.4	0
Agaric	Bacterial brown spots	72.8	-
	Green mold disease	90.7	-

5 As seen in the results of Table 3, sterilizing water prepared by the apparatus according to the present invention has an effect for preventing agricultural diseases, and the effect is more excellent than that of commercially available agricultural chemicals.

10

Example 4: Sterilizing effect when washing hands

After applying E. coli on a hand, the hand was washed by being soaked in 5 liter of the sample. Then, four fingers were rubbed on a medium to measure the number of 15 remained bacteria. For the control, Super-Sterilizer and Alpet-E (commercially available hand sterilizers) were used. Identical tests were repeated six times, and the

mean values are shown in Table 4 below.

Table 4: Sterilizing effect when washing hands

	No. of remaining bacteria after washing	Reduction rate of bacteria (%)
Untreated group	$1.0 \times 10^5$	-
Super-Sterilizer	$1.5 \times 10^2$	99.8
Alpet-E	$4.9 \times 10^2$	99.5
Sterilizing water of the invention	3	99.9

5 As shown in the results of Table 4, the sterilizing water prepared by the apparatus of the present invention has an excellent sterilizing effect as compared with commercially available sterilizers for washing hands and thus can be employed as a sterilizer for medical use.

10

Example 5: Test of toxicity

(1) Test for acute toxicity

A test for acute toxicity of the sterilizing water prepared according to Example 1 was performed by using 5 weeks-old ICR mouse having a body weight of  $20 \pm 3$  g. As a critical test, 5000 mg/kg of sterilizing water was administered, and the concentration was adjusted to 500 mg/ml. The sample was orally administered once at a rate of 1 ml/100 g. For a negative control, the sterilized 15 physiological saline was administered.

For 6 hours after administration, the animals were observed every hour. Then, activity, appearance and symptoms related to autonomic nerves of the mice were carefully observed once a day during 14 days thereafter. 20 A body weight of each animal was measured on the day of administration and 5 days after the administration, and compared with that of the control group. No extraordinary 25 change was found.

## (2) Test of eye irritation

A test of eye irritation by sterilizing water prepared from Example 1 of the present invention was performed by using 3-4 months-old New Zealand white rabbits, each having a body weight of 2.0 to 3.0 kg. Nine rabbits were selected, and 0.1 ml of sterilizing water prepared from Example 1 was administered dropwise on the eye membrane of right eye of each rabbit. After 30 seconds, both eyes of three among them were washed with sterile physiological saline for 1 minutes, while the eyes of remaining 6 rabbits were not washed. The left eye of each rabbit, with no administration of sample, was used as a control.

After administering sterilizing water, the rabbits were observed everyday in view of general symptoms and intake of food and water. The eye test was performed after 1, 24, 48, 72 and 96 hours, and seven days after administration of sterilizing water. On the basis of the table for judging the eye membrane irritation and table for grading pathological change of eyeballs according to "the Standard for Toxicity Test of Medicines or the like", Notification No. 94-3 by the National Health and Safety Institute, the pathological change of each eye was graded, and the state of irritation was evaluated.

As a result, it was confirmed that no substantial irritation was found on the eye membrane of the test rabbits.

Example 6: Test of Durability

An apparatus for preparing sterilizing water equipped with the gasket according to the present invention and an apparatus for electrolysis employing a gasket having a single passage without a horizontal member instead of the gasket according to the invention, as a comparative example, were operated for about six months in an identical condition. After 6 month operation, the ion exchange membrane of each electrode was taken and

photographed. (Figs. 4A and 4B)

As seen in Fig. 4, in case of using a gasket of conventional structure, Ca or Mg precipitate generated as a side product of electrolysis was deposited on the ion exchange membrane (left of Fig. 4A) or the electrode (left of Fig. 4B), which could not be used further. On the other hand, the apparatus for preparing sterilizing water according to the present invention showed much less deposition of precipitate on the ion exchange membrane (right of Fig. 4A) and no deposition of precipitate at all on the electrode (right of Fig. 4B).

As described above, sterilizing water prepared with a very low electric potential according to the present invention shows an excellent sterilizing power against various microorganisms and thus can be advantageously used in the field of agriculture and medical treatment as well as everyday life. Sterilizing water prepared by the apparatus according to the present invention, though being consisting of pure water, shows an excellent sterilizing power, and thus it does not cause environmental pollution as compared to conventional chemical sterilizers, thereby contributing to environmental protection.

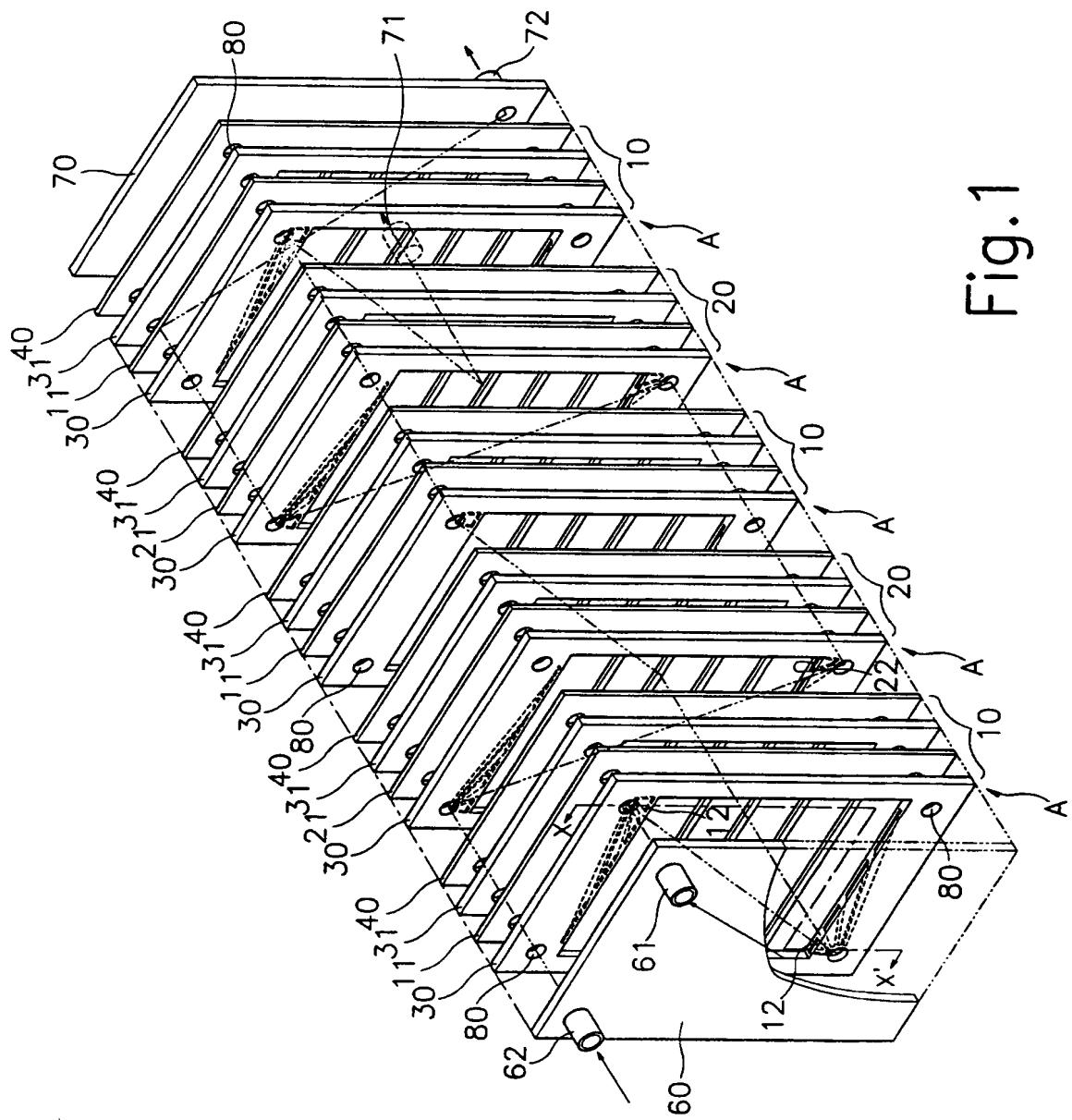
## CLAIMS:

1. An apparatus for preparing sterilizing water, which comprises an electrolyzer wherein an anode chamber (10) and a cathode chamber (20) partitioned by an ion exchange membrane (40) form a unit cell(A), being alternately arranged and successively equipped with close relation; water inlets (61, 62) and water outlets (71, 72) are provided on the end plate (60,70) at both ends of the electrolyzer; said anode chamber (10) and cathode chamber (20) having circulative openings at the vicinity of each edge at both side centered from anode plate (11) and cathode plate (21), of which two circulative openings of diagonal direction among them have plural passages of fan-shape, in order for water introduced through the openings to pass through the passages to rapidly go through each electrode; and a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) having plural horizontal members are provided at the center to form an anode reaction chamber (13) and a cathode reaction chamber (23).
2. An apparatus for preparing sterilizing water according to claim 1, wherein the anode passage (21) and the cathode passage (22) formed in each gasket (30, 31) make the water introduced through the water inlet (61, 62) flow in through the anode passage (12) and the cathode passage (22).
3. An apparatus for preparing sterilizing water according to claim 2, wherein a dimension stable anode (DSA) using an oxygen-generating catalyst or platinum plating on titanium substrate is employed as an anode plate (11).
4. An apparatus for preparing sterilizing water according to claim 2, wherein the cathode plate (21)

employs hydrogen-generating catalyst in addition to the substrate made of stainless steel, nickel, mild steel or titanium.

- 5 5. An apparatus for preparing sterilizing water according to claim 3 or 4, wherein the hydrogen- or oxygen-generating catalyst is iridium or ruthenium.

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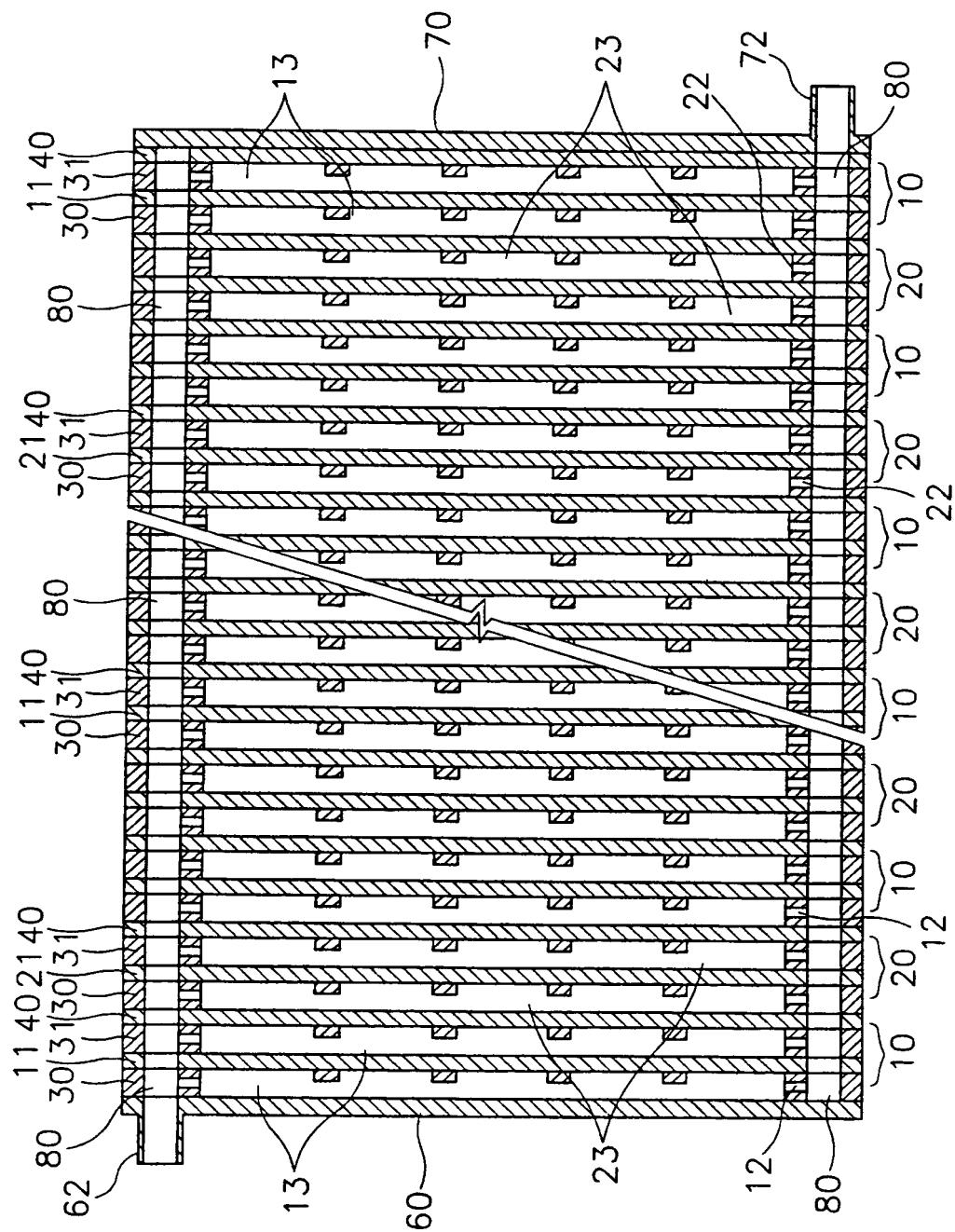


Fig. 2

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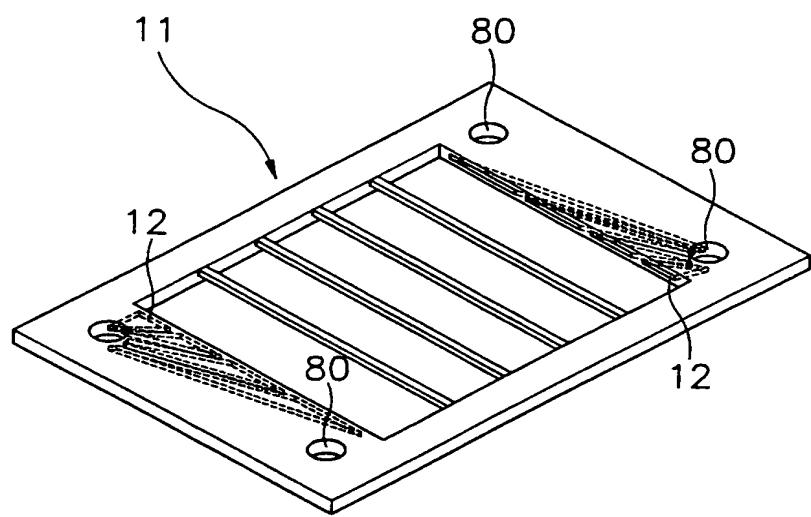


Fig.3

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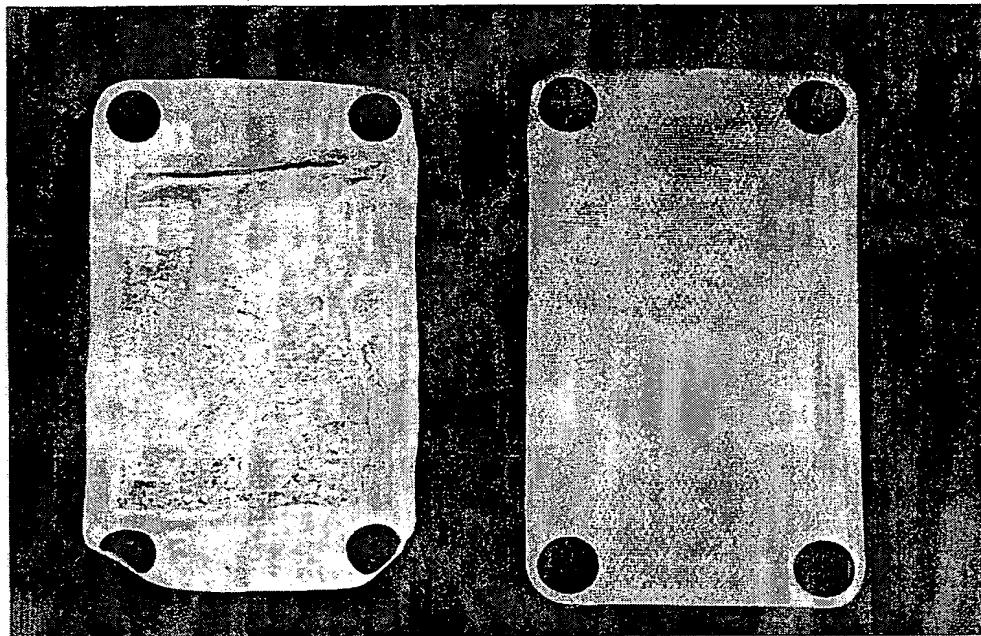


Fig.4a

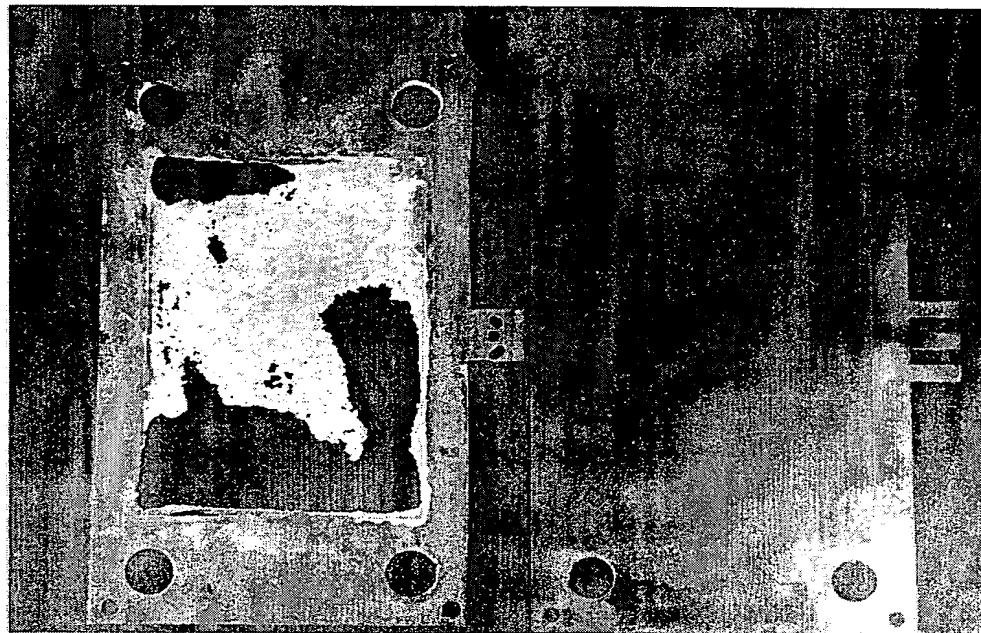


Fig.4b

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR 99/00509

## CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup>: C 02 F 1/461

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>7</sup>: C 02 F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5322604 A (CAWLFIELD) 21 June 1994 (21.06.94) totality.	1
A		2-5
Y	EP 0601284 A2 (TOHO TECHNICAL SERVICE CO) 15 June 1994 (15.06.94) claims.	1
A	US 5615764 A (SATOH) 1 April 1997 (01.04.97) totality.	1-5
A	US 4729822 A (JAMES) 8 March 1988 (08.03.88) totality.	1-5
A	US 4589968 A (TOOMEY, Jr.) 20 May 1986 (20.05.86) totality.	1-5

 Further documents are listed in the continuation of Box C. See patent family annex.

## \* Special categories of cited documents:

..A" document defining the general state of the art which is not considered to be of particular relevance

..E" earlier application or patent but published on or after the international filing date

..L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

..O" document referring to an oral disclosure, use, exhibition or other means

..P" document published prior to the international filing date but later than the priority date claimed

..T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

..X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

..Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

..&amp;" document member of the same patent family

Date of the actual completion of the international search

2 May 2000 (02.05.2000)

Date of mailing of the international search report

2 August 2000 (02.08.2000)

Name and mailing address of the ISA/AT

Austrian Patent Office

Kohlmarkt 8-10; A-1014 Vienna

Facsimile No. 1/53424/535

Authorized officer

Koller

Telephone No. 1/53424/458

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/KR 99/00509

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 09262583 A (PERMELEC ELECTRODE LTD.) 7 October 1997 (07.10.97) abstract; In Patent Abstracts of Japan [CD-ROM]. -----	1-5

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
PCT/KR 99/00509

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP A2 601284	15-06-1994	DE C0 69305726	05-12-1996
EP A3 601284	18-01-1995	DE T2 69305726	03-04-1997
EP B1 601284	30-10-1996	JP A2 6226258	16-08-1994
		US A 5340458	23-08-1994
JP A2 9262583	07-10-1997	none	
US A 4589968	20-05-1986	CA A1 1234779 DE C0 3481323 EP A1 122736 EP A1 334394 EP B1 122736 JP A2 59197585 JP B4 8023076	05-04-1988 15-03-1990 24-10-1984 27-09-1989 07-02-1990 09-11-1984 06-03-1996
US A 4729822	08-03-1988	AT E 48445 AU A1 63529/86 AU B2 577964 BR A 8605099 CA A1 1310299 DD A5 250138 DE C0 3667304 EP A1 220846 EP B1 220846 FI A0 864211 FI A 864211 FI B 80298 FI C 80298 GB A0 8526054 GB A0 8623574 IE B 57505 IL A0 80344 IL A1 80344 IN A 169743 JP A2 62099489 JP B4 6080193 LT A3 2088 MX B 168009 NO A0 864204 NO A 864204 NO B 166801 NO C 166801 NZ A 217989 PL A1 261982 PL B1 148626 PT A 83590 PT B 83590 SU A3 1662353 TR A 22996 ZA A 8607649	15-12-1989 30-04-1987 06-10-1988 21-07-1987 17-11-1992 30-09-1987 11-01-1990 06-05-1987 06-12-1989 17-10-1986 23-04-1987 31-01-1990 10-05-1990 27-11-1985 05-11-1986 10-03-1993 30-01-1987 31-07-1989 14-12-1991 08-05-1987 12-10-1994 15-07-1993 28-04-1993 21-10-1986 23-04-1987 27-05-1991 04-09-1991 29-08-1989 02-11-1987 30-11-1989 29-05-1987 30-07-1993 07-07-1991 01-01-1989 24-06-1987
US A 5322604	21-06-1994	AU A1 53228/94 AU B2 672255 BR A 9307359 CA AA 2148239 EP A1 666935 EP A4 666935 JP T2 8502788 NZ A 257024 WO A1 9410359	24-05-1994 26-09-1996 01-06-1999 11-05-1994 16-08-1995 27-09-1995 26-03-1996 27-02-1996 11-05-1994
US A 5613764	25-03-1997	none	

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

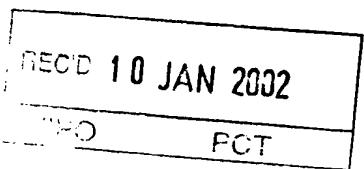
Date of mailing (day/month/year) 20 July 2000 (20.07.00)	To:  LEE, Hoo, Dong 7th-11th floors Hankook Tire Building 647-15, Yoksam-dong Kangnam-ku Seoul 135-723 RÉPUBLIQUE DE CORÉE
Applicant's or agent's file reference 99-OPA-1782	<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/KR99/00509	International filing date (day/month/year) 03 September 1999 (03.09.99)

1. The following indications appeared on record concerning: <input checked="" type="checkbox"/> the applicant <input type="checkbox"/> the inventor <input type="checkbox"/> the agent <input type="checkbox"/> the common representative				
Name and Address  KYUNGWON ENTERPRISE CO., LTD. RM 809 Winners Officetel 175-2, Chamsil-dong Songpa-gu Seoul 138-220 Republic of Korea	State of Nationality KR		State of Residence KR	
	Telephone No.			
	Facsimile No.			
	Teleprinter No.			
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning: <input type="checkbox"/> the person <input type="checkbox"/> the name <input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence				
Name and Address	State of Nationality		State of Residence	
	Telephone No.			
	Facsimile No.			
	Teleprinter No.			
3. Further observations, if necessary: <b>Please note that the applicant indicated in Box 1 has been deleted from the record. KIM, Hee, Jung remains sole applicant/inventor for all designated States.</b>				
4. A copy of this notification has been sent to: <input checked="" type="checkbox"/> the receiving Office <input type="checkbox"/> the designated Offices concerned <input checked="" type="checkbox"/> the International Searching Authority <input type="checkbox"/> the elected Offices concerned <input type="checkbox"/> the International Preliminary Examining Authority <input type="checkbox"/> other:				

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Kari Huynh-Khuong  Telephone No.: (41-22) 368.83.38
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**INTERNATIONAL COOPERATION TREATY  
PCT**

**INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)**



Applicant's or agent's file reference 99-OPA-1782	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/KR99/00509</b>	International filing date (day/month/year) 03 SEPTEMBER 1999 (03.09.1999)	Priority date (day/month/year)
International Patent Classification (IPC) or national classification and IPC <b>IPC7 C02F 1/461</b>		
Applicant KIM. Hee Jung		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>3</u> sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>2</u> sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>

Date of submission of the demand 23 MARCH 2001 (23.03.2001)	Date of completion of this report 13 DECEMBER 2001 (13.12.2001)
Name and mailing address of the IPEA/KR Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer HONG, Soon Chil Telephone No. 82-42-481-5542



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/KR99/00509

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

 the international application as originally filed the description:pages 1 - 15 \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_ the claims:pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, as amended (together with any statement) under Article 19  
pages 16 - 17 \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_ the drawings:pages 1 - 4 \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_ the sequence listing part of the description:pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is

 the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

 contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4.  The amendments have resulted in the cancellation of: the description, pages \_\_\_\_\_ the claims, Nos. 5 \_\_\_\_\_ the drawings, sheet \_\_\_\_\_5.  This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed," and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/KR99/00509

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims	1 - 4	YES
	Claims		NO
Inventive step (IS)	Claims	1 - 4	YES
	Claims		NO
Industrial applicability (IA)	Claims	1 - 4	YES
	Claims		NO

## 2. Citations and explanations (Rule 70.7)

Reference is given to the following documents:

D1 : US-A-5,322,604

D2 : EP-A2-601,284

D3 : US-A-5,615,764

I . Novelty and Inventive step.

The claimed invention is not considered to be anticipated by the patent documents cited. None of these documents reveal the apparatus for preparing sterilizing water and process for sterilizing water, as described in the claims.

The invention according to claims (1-4) is therefore considered to be new to involve an inventive step.

Therefore, the novelty and inventive step of the present invention can be acknowledged, based on Article 33(2) and 33(3) of the PCT

II . Industrial Applicability.

The subject matter of these claims (1-4) meets the criteria set out in Article 33(4) of the PCT

**CLAIMS:**

1. An apparatus for preparing sterilizing water, comprising:

5 an electrolyzer wherein an anode chamber (10) and a cathode chamber (20) partitioned by an ion exchange membrane (40) form a unit cell(A), being alternately arranged and successively equipped with close relation;

10 water inlets (61, 62) and water outlets (71, 72) being provided on the end plate (60,70) at both ends of the electrolyzer;

15 said anode chamber (10) and cathode chamber (20) having circulative openings at the vicinity of each edge at both side centered from anode plate (11) and cathode plate (21), of which two circulative openings of diagonal direction among them have plural passages of fan-shape, in order for water introduced through the openings to pass through the passages to rapidly go through each electrode;

20 a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) having plural horizontal members are provided at the center to form an anode reaction chamber (13) and a cathode reaction chamber (23); and

25 a anode passage (12) and a cathode passage (22) formed in each gasket (30, 31) and making the water introduced through the water inlet (61, 62) flow in there through.

2. An apparatus for preparing sterilizing water according to claim 1, wherein a dimension stable anode (DSA) using an oxygen-generating catalyst or platinum plating on titanium 30 substrate is employed as an anode plate (11).

3. An apparatus for preparing sterilizing water according to claim 1, wherein the cathode plate (21) employs hydrogen-generating catalyst in addition to the substrate made of 35 stainless steel, nickel, mild steel or titanium.

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IPEA/KR 29.03.2001.

4. An apparatus for preparing sterilizing water according to claim 3 or 4, wherein the hydrogen- or oxygen-generating catalyst is iridium or ruthenium.